Fire fighting systems for transport applications
Fire fighting systems for transport applications

Promel provides fire detection and fire fighting systems, originally developed for oil&gas applications, that can be used in transport applications, both on board and in stations.
For transport application it is available FGP-05s fire control unit, described in this document; in addition to FGP-05s unit, Promel can supply fire control units designed in accord with Customer’s specifications.

1. Description of FGP-05s control unit

The main characteristics of an FGP-05s system are reported in the table below.

| Housing                                      | Standard rack 19” 3U (482x133x302mm) or 6U (482x266x302mm); the height 3U or 6U depends on the required number of input and output signals. Electronic cards are single Eurocard. A 3U rack can host 12 cards (24 cards can be installed in a 6U rack). |
| Electrical connections                       | Available on the rear side of the unit. Connectors are provided for communication lines, while the connections with the field and for power supply are done through wire clamp screw socket; on request, all the connections can be done through connectors. |
| Architecture                                 | Multiprocessor with TMR (triple modular redundant) technology. |
| Safety Integrity Level for fire detection, fire alarm and fire fighting | SIL2 / SIL3 |
| Power supply                                | Redundant 24V |
| Power consumption                           | Max 75W for 3U version, 150W for 6U |
| Operating temperature                       | -25°C ÷ +85°C |
| Communication interface                     | Serial (MODBUS) / Ethernet (MODBUS TCP) |
| Service interface                            | RS232 / RS485 |
| Operator interface                          | The front panel hosts a display (256 x 128 pixel), 31 led and a keyboard (16 keys). System status visualization and programming functions are available (three level access for operations are defined, according to EN 54-2 standard). Two pushbuttons for reset commands are on front panel. |
| Safety functions for input and output lines | a) Line check for open/short circuit;  
b) one input signal can be connected to different cards and the value is chosen through voting;  
c) the command for one output signal can be done from two different cards. |
Thanks to the modularity of the system, it is possible to have the number of input and output lines required in all applications (for sensors reading, actuators command, signals and alarms activation,...). The number of input and output depends on the number of I/O cards used (a 3U rack system has 9 slot for input and output cards).

Four types of input and output boards are available:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI4020</td>
<td>Analog input 4 – 20 mA, 6 channels</td>
</tr>
<tr>
<td>DI14</td>
<td>Digital input, 14 channels</td>
</tr>
<tr>
<td>DO14</td>
<td>Digital output, 24Vdc – 2A, 14 channels</td>
</tr>
<tr>
<td>DO14R</td>
<td>Relay output, 24Vdc – 2A, 14 channels</td>
</tr>
</tbody>
</table>

The capability of defining number and type of input and output lines allows easy implementation of all the functions required. Some functions are: selective shout-down, ventilation switch-off, closing HVAC external shutters, closing fire-barrier doors\(^1\), reading pressure or weight sensors, acquiring the status of external switches (for manual commands).

The unit can manage temperature sensors, smoke detectors and UV/IR sensors, also addressable type; the unit is compatible with all fire extinguishing systems.

For system operations several zones are set; for each zone independent operations can be defined, following the requirements of the application. The led on front panel show the status of each zone:

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>release inhibited</td>
<td>The led is on when extinguishing agent discharge is electrically inhibited</td>
</tr>
<tr>
<td>(yellow)</td>
<td>(by field switches, front panel key selector, by code etc...).</td>
</tr>
<tr>
<td>trip (red)</td>
<td>The led is on every time an alarm is detected.</td>
</tr>
<tr>
<td>release (red)</td>
<td>It blinks when solenoid valves are activated (for discharge command); it</td>
</tr>
<tr>
<td></td>
<td>turns on when a release of extinguishing agent is detected.</td>
</tr>
<tr>
<td>zone fault (yellow)</td>
<td>It shall turn on every time there is a fault in a specific zone.</td>
</tr>
<tr>
<td>system inhibited</td>
<td>The led turns on when extinguishing agent discharge is mechanically</td>
</tr>
<tr>
<td>(yellow)</td>
<td>inhibited, i.e. when all isolation valves are fully closed.</td>
</tr>
<tr>
<td>manual mode (yellow)</td>
<td>It shall turn on when category A (*) of I/O is set out of service.</td>
</tr>
<tr>
<td>out of service (yellow)</td>
<td>It shall turn on when at least one category is set out of service.</td>
</tr>
</tbody>
</table>

(*) The I/O lines are grouped in categories; category A includes fire sensors signals and signals related to alarms.

A delay from the alarm activation to discharge of extinguishing agent can be defined; two discharge banks can be managed, main and reserve bank.

The system status information is transmitted through communication interface.

\(^1\) These functions are required on railway vehicles (refer to Italian standard UNI CEI 11170 part 2 and to European standard EN 45545-6)
1.1 Reference standards

EN 50155           Railways application - Electronic equipment used on rolling stock
UNI CEI 11170        Railway and tramway vehicles – Guidelines for fire protection of railway, tramway and guided path vehicles (Italian standard)
EN 45545            Railway applications – Fire protection on railway vehicles
U94.02.057.0        Design, installation, validation and maintenance of fire detection and extinguishing systems for railway vehicles (UNIFER, proposal for UNI standard)
EN 12094-1          Fixed firefighting systems Components for gas extinguishing systems Part 1: Requirements and test methods for electrical automatic control and delay devices
EN 54-1             Fire detection and fire alarm systems - Introduction
EN 54-2             Fire detection and fire alarm systems - Control and indicating equipment
EN 54-4             Fire detection and fire alarm systems - Power supply equipment
NFPA 72 National Fire Alarm Code  
CEI EN 61508 Functional safety of electrical / electronic / programmable electronic safety-related systems  
CEI EN 61511 Functional safety – Safety instrumented systems for the process industry sector System Safety  
2004/198/EC EMC Directive  
2006/95/EC Low Voltage Directive  
EN 61000-6-2 EMC - Immunity for industrial environments  
EN 61000-6-4 EMC - Emission standard for industrial environments  
EN 55011 Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical radio-frequency equipment  
EN 61000-3-2 EMC – Limits for harmonic current emissions  
EN 61000-4-2 EMC – Testing and measurement techniques – Electrostatic discharge immunity test  
EN 61000-4-3 Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test  
EN 61000-4-4 Testing and measurement techniques – Electrical fast transient /burst immunity test  
EN 61000-4-5 Testing and measurement techniques – Surge immunity test  
EN 61000-4-6 Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields  
EN 61000-4-11 Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests

1.2 Certifications


CERTIFICAZIONE SIL The Promel’s certification is based on an FMEDA assessment validated by Exida GmbH (report Promel 06-12-35 R008, July 17, 2009): the equipment is suitable for SIL2/SIL3 applications with time proof interval of 1 year, maximum 10 years.
2 Applications on railway vehicles

The FGP-05s unit is able to implement all the functions required in specifications UNI EN 11170 part 2, EN 45545 and UNIFER U94.02.075.0: fire detection, activation of alarms, equipment shutdown, extinguishing agent release. The unit offer the safety level required in Italian specification UNIFER U94.02.075.0.

The definition of detection zones (in passenger and technical areas) and of zones for automatic fire suppression (when required) depends on the vehicle type; the type of detectors depends on the area to be protected.

The system’s architecture may be defined as a function of the application. We can use one unit per coach or one unit controlling several coaches; in the first case, in order to reduce the size, the unit can be provided in a compact form, with housing different from a 19” rack.

When the unit controls several coaches, it is convenient to have a 19” rack that allows expanding and configuring the system through adding new boards.

During vehicle’s revamping, the FGP-05s can be used for adding the fire protection in coaches originally not equipped with this function, as required by UNI CEI 11170 Italian norm; for this kind of application, it is useful to have one unit per coach.

The actions performed when an alarm condition is detected will be defined as function of the application and the Customer’s requirements. We can have: ventilation switch-off, closing HVAC external shutters, high and medium voltage devices switch-off, selective shutdown of not-essential electrical functions, fire barrier doors closing and, when required, automatic suppression in the affected area.

In addition to automatic mode, the manual mode is available (this mode can be activated with external switches).

If a vehicle control unit is available, FGP-05s signals to it the alarm conditions, through Ethernet interface (other types of interface can be used, if required); the activation of alarms for the passengers and the crew can be performed by FGP-05s unit itself or by the vehicle control unit.

3 Systems for metros

FGP-05s control unit can be used for fire protection in metros, both on board and in stations.

The proposed system for the metros is based on using several control units for fire detection, alarm management e, when required, fire suppression. It is provided a unique type of control unit; the unit is modular and its configuration depends on the area of application (vehicles or ground) and on the operations required.

Various technical solutions are available for fire extinguishing, to be defined depending on the application area.
3.1 Vehicle’s control unit

It is considered one control unit per coach; different architectures can be implemented for reducing the number of control units required for one vehicle.

The controller functions are those described in the norms UNI CEI 11170 part 2, EN 45545 and UNIFER U94,02.075.0. Each unit manages different zones for fire detection and, when required, fire suppression, in passenger areas, in the air ducts and in areas reserved to the equipment.

The presence of alarms will be notified to the vehicle’s control unit through the Ethernet interface (other types of interface may be considered); the latter unit is responsible for management of the information for passenger.

The operations of the unit when an alarm is detected are defined depending on the application and on Customer’s requirements. For example, the unit can stop the ventilation and close the shutters of air conditioning, switch-off the high and medium voltage devices, turn-off non-essential electrical functions, command the automatic fire suppression in the affected area.

In addition to the automatic mode, it is provided a manual mode, activated by external switches.

The control unit is in a 19” 3U rack (this allows for a configurable and extensible system through the addition of new cards); if necessary, different mechanical configurations can be studied.

3.2 Control unit for ground systems

We consider a distributed structure with several control units, each dedicated to an area or group of areas to be protected (transit areas, spaces for passengers, shopping areas, technical areas, passages for cables under the docks, ...); all control units communicate with a central unit for management of alarms and of information for passengers.

Different types of sensors can be used for each area (smoke detector, temperature sensors, heat-sensitive cables ...); the operations performed when an alarm is detected depend on the area covered by the control unit, such as closing the protective barriers or control the automatic fire extinction (refer to Italian Ministerial Decree of January 1988).

In addition to the automatic mode, manual operations are provided.

It is possible to have the control unit in 19” 3U or 6U rack (the size depends on the number of inputs and outputs lines available); if required, different mechanical configurations can be studied.